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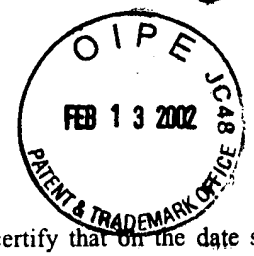

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January 30, 2002
Date

Stephanie Jansen

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	: Salman Akram; Alan G. Wood; and Warren M. Farnworth	Attorney Docket No.:	500185.03
Serial No.	: 09/631,900	Group Art Unit	: 2815
Filed	: August 4, 2000	Examiner	: Lourdes C. Cruz
Title	: APPARATUS AND METHODS OF TESTING AND ASSEMBLING BUMPED DEVICES USING AN ANISOTROPICALLY CONDUCTIVE LAYER		

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Washington, DC 20231

AMENDMENT

Sir:

Applicants acknowledge receipt of the Office Action dated December 14, 2001.

REMARKS

Claims 1, 3, 5-12, and 15-17 are pending in the application. In the Office Action dated December 14, 2001, the Examiner took the following action: (1) withdrew claims 15-17 from further consideration pursuant to 37 CFR § 1.142(b) as being drawn to a non-elected specie; (2) rejected claims 8 and 12 under 35 USC § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention; (3) rejected claims 1, 3, and 5-12 under 35 USC § 102(e) as being

anticipated by Sako (U.S. Patent No. 6,137,183). Applicants respectfully request reconsideration of the application in view of the foregoing amendments and the following remarks.

Some of the technical differences between the applied references and various embodiments of the invention will now be discussed. Of course, these discussed differences, which are disclosed in detail in the patent specification, do not define the scope or interpretation of any of the claims. Where presented below, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

Generally, Applicants teach apparatus and methods of testing and assembling bumped devices using an anisotropically conductive layer. In one embodiment, a semiconductor device includes a surface having a plurality of conductive bumps formed thereon, a substrate having a plurality of substantially flat contact pads distributed thereon and approximately aligned with the plurality of conductive bumps, and an anisotropically conductive layer disposed between the bumped device and the substrate. The anisotropically conductive layer is mechanically coupled to the substrate and has a flexible outer surface in contact with the plurality of conductive bumps. The conductive bumps are not embedded within the anisotropically conductive layer. Rather, the conductive bumps compress the flexible outer surface to form a compression area at each of the conductive bumps and to electrically couple each of the conductive bumps with a corresponding one of the contact pads. In an alternate aspect, the flexible outer surface is a resilient outer surface.

In certain particular embodiments, the contact pads are located within pockets formed in the substrate and the anisotropically conductive material is disposed therein to form the electrically conductive contact between the bumps and the contact pads located in the pockets. The pockets are located at predetermined positions in the testing substrate to receive a device with a corresponding configuration of conductive bumps. This advantageously permits the device containing conductive bumps to be easily aligned with, inserted into, and removed from electrical contact with the pads in the test device, so that one test device with one configuration of pockets may easily be used to test multiple devices containing the proper configuration of bumps.

In operation, test signals may be transmitted to and received from the bumped device through the contact pads via the anisotropically conductive layer. After the bumped

device has been tested, it may be disengaged from the substrate by simply moving the conductive bumps away from the flexible outer surface of the anisotropically conductive layer. If the flexible outer surface is a resilient surface, the localized compression areas near each of the conductive bumps will spring back to their uncompressed shape.

The substrate having the anisotropically conductive layer with the flexible outer surface may advantageously improve the process of testing of the bumped device by reducing or eliminating the time and effort involved in detaching the conductive bumps from the anisotropically conductive layer. Because the conductive bumps are not embedded in the layer, it is not necessary to reheat the apparatus to the rework temperature of the anisotropically conductive layer in order to disengage the bumped device from the substrate. The time, effort, and expense associated with disengaging the conductive bumps from the anisotropically conductive layer may therefore be reduced or eliminated.

Similarly, because the conductive bumps are not embedded in the anisotropically conductive layer, the time, effort, and expense associated with cleanup of any residual anisotropically conductive material deposited on the conductive bumps may also be reduced or eliminated. Depending upon the anisotropically conductive material used, the transfer of material to the conductive bumps may be minimized or eliminated so that the conductive bumps may be clean enough for immediate use after testing.

Sako . In contrast, Sako discloses a method of mounting an integrated circuit flip chip having bumps by engaging a flat substrate using through an anisotropically conductive film (ACF) in combination with an adhesive paste that may optionally also be anisotropically conductive. The adhesive paste is designated ACP when is anisotropically conductive, but expressly many not be anisotropically conductive in certain embodiments (see col. 9, line 7, and col. 10, lines 6-8). There is no further similarity between Sako and Applicants' disclosed embodiments.

In particular, Sako does not disclose pockets in the substrate and also does not disclose contact pads within a pocket. In fact, Sako fails to disclose contact pads at all, let alone contact pads disposed in pockets in the substrate. In this regard the Examiner has incorrectly characterized Figure 2 of Sako. Applicants acknowledge that Sako discloses a bumped device 1

having conductive bumps 2 which are mounted with an adhesive 3 and an ACF 4 to a substrate 5 as previously mentioned. However, there is no pocket in the substrate and there is no bonding pad in the pocket as stated by the Examiner. What the Examiner apparently believes to be a pocket, is in fact, a deformation in the ACF 4 that results from pressing the chip into the otherwise flat ACF 4 disposed above the flat substrate 5. Furthermore, what the Examiner apparently believes to be a bonding pad is, in fact, merely an area where the adhesive 3 mixes with the ACF 4 as a result of the same pressure. More specifically, Sako expressly discloses:

> As shown in FIG. 2, the paste-like adhesive 3 and the ACF 4 are deformed by a pressure force applied by the flip chip bonder, and an area adjacent to the bumps 2 presents the largest deformation. The paste like adhesive 3 and the ACF 4 that are present beneath the bumps 2 increase their fluidity at the time of heat bonding, and a mixed region 8 of the paste-like adhesive 3 and the ACP is formed. ....Accordingly, a pressure force of about 50-100 g for each bump is required to generate a deformation shown in FIG. 2 to obtain electrical connection.

(col. 7, lines 10-15 and 33-35, emphasis added).

Hence, in contrast to Applicants' embodiments where the pocket is formed *in the substrate* and is used to facilitate alignment and electrical contact between bonding pads located within the pocket and the bumps, no such alignment is possible in the device disclosed by Sako, which altogether lacks both pockets and pads. Further, the mixed region 8 of Sako would not be considered the same as a bonding pad because the mixed region is a combination of adhesive and ACF that will result anywhere the bump is pressed into the adhesive applied atop the ACF 4. In contrast, a contact pad is an electrically conductive material, usually a metal, which is typically attached to a lead, and which is precisely positioned at a predetermined location along the substrate within the pockets as taught by Applicants.

Turning now to the specific language of the claims, claims 1 and 9 recite in pertinent part, a substrate having a plurality of pockets disposed therein and a plurality of contact pads distributed thereon and approximately aligned with the plurality of conductive bumps, each contact pad being at least partially disposed within one of the pockets (emphasis added). As discussed more fully above, Sako altogether fails to disclose a substrate containing pockets and fails to disclose pockets containing contact pads, or any pads for that matter.

Claims 3, and 5-8 depend from claim 1 and are patentable over Sako at least for this reason, but on separate grounds as well. For example, claim 3 recites that the conductive bumps are partially engaged within the pockets. Not only does Sako fail to disclose pockets, the reference as whole would teach away from any embodiment with partial engagement of electrical contact because one of ordinary skill in the art would understand the purpose and teaching of Sako to be directed to forming permanent engagement between a device and substrate as a substitute for soldering. Hence, partial engagement of the bumps would tend to depart from the teaching Sako as a whole.

Claim 6 recites in pertinent part, that the anisotropically conductive layer comprises a thermoplastic anisotropically conductive adhesive. The thermoplastic adhesive facilitates the resilience discussed in more detail above for certain embodiments. Sako if anything, teaches away from using a thermoplastic material by stating "In recent years, the type of adhesive binder has been changing from the thermoplastic type to the thermosetting type for higher connection reliability." (col. 6, line 58).

Claims 10-12, which depend from claim 9 similarly recite patentably distinct features over Sako. For example, claim 10 that the anisotropically conductive layer includes a flexible outer surface and claim 11 recites that the anisotropically conductive layer includes a resilient outer surface. Sako fails to teach or suggest anything concerning a flexible or resilient surface for the anisotropically conductive film.

With respect to claims 15-17, which were withdrawn by the Examiner because they relate to a non-elected species, Applicants submit that these claims depend from allowable generic claim 9 and therefore request the Examiner to reinstate these claims at the present time.

CONCLUSION

In light of the foregoing amendments and remarks, Applicants believe that pending claims 1, 3, 5-12, and 15-17 are in condition for allowance, and that action is respectfully requested. If there are any remaining matters that can be handled in a telephone conference, the Examiner is invited to telephone the undersigned attorney, Mark W. Roberts, at (206) 903-8728

Respectfully submitted,
DORSEY & WHITNEY LLP

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